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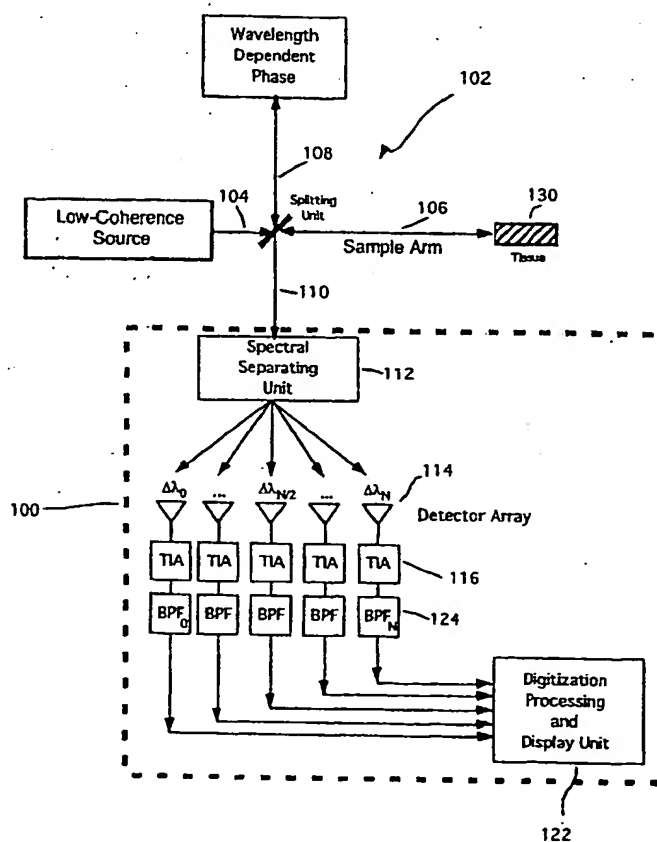
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[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR RANGINGS AND NOISE REDUCTION OF LOW COHERENCE INTERFER-  
OMETRY LCI AND OPTICAL COHERENCE TOMOGRAPHY (OCT) SIGNALS BY PARALLEL DETECTION OF SPECTRAL  
BANDS



(57) Abstract: Apparatus, method, logic arrangement and storage medium are provided for increasing the sensitivity in the detection of optical coherence tomography and low coherence interferometry ("LCI") signals by detecting a parallel set of spectral bands, each band being a unique combination of optical frequencies. The LCI broad bandwidth source can be split into N spectral bands. The N spectral bands can be individually detected and processed to provide an increase in the signal-to-noise ratio by a factor of N. Each spectral band may be detected by a separate photo detector and amplified. For each spectral band, the signal can be band pass filtered around the signal band by analog electronics and digitized, or, alternatively, the signal may be digitized and band pass filtered in software. As a consequence, the shot noise contribution to the signal is likely reduced by a factor equal to the number of spectral bands, while the signal amplitude can remain the same. The reduction of the shot noise increases the dynamic range and sensitivity of the system.

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European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G01N21/47 A61B3/00 G01B9/02 H03L7/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC 7 G01N A61B G01B H03L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EP0-Internal, WPI Data, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 134 003 A (BOPPART STEPHEN A ET AL) 17 October 2000 (2000-10-17) column 16, line 36 -column 17, line 24; figure 16	1-58,71, 101,102
X	US 5 317 389 A (HOCHBERG ERIC B ET AL) 31 May 1994 (1994-05-31) column 5, line 45 -column 6, line 19; claims 1,2; figure 2	1-58,71, 101,102
A	US 6 141 577 A (DELFYETT JR PETER J ET AL) 31 October 2000 (2000-10-31) column 4, line 50 -column 5, line 37; figure 3	1-58,71, 101,102
-/--		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the International filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art *Z* document member of the same patent family		
Date of the actual completion of the international search  11 September 2003		Date of mailing of the international search report  19.09.03
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016		Authorized officer  Consalvo, D

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>TEARNEY G J ET AL: "IN VIVO ENDOSCOPIC OPTICAL BIOPSY WITH OPTICAL COHERENCE TOMOGRAPHY" SCIENCE, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,, US, vol. 276, no. 5321, 27 June 1997 (1997-06-27), pages 2037-2039, XP001041246 ISSN: 0036-8075 figure 1</p>	1-58,71, 101,102
A	<p>WO 99 44089 A (GEN HOSPITAL CORP ;TEARNEY GUILLERMO J (US); BOUMA BRETT E (US); W) 2 September 1999 (1999-09-02) figure 1</p>	1-58,71, 101,102
X	<p>US 4 925 302 A (CUTLER GREGORY M) 15-May 1990 (1990-05-15)</p> <p>column 5, line 14 -column 6, line 25; figures 3,4</p>	59-69, 85,86, 88-90, 92,93,98
X	<p>US 4 631 498 A (CUTLER GREGORY M) 23 December 1986 (1986-12-23)</p> <p>claims 1-6; figure 1</p>	59-69, 85,86, 88-90, 92,93,98
A	<p>GB 2 209 221 A (LITTON SYSTEMS INC) 4 May 1989 (1989-05-04)</p> <p>figure 6</p>	59-69, 85,86, 88-90, 92,93,98
A	<p>US 6 069 698 A (TAKIZAWA HIRONOBU ET AL) 30 May 2000 (2000-05-30)</p> <p>the whole document</p>	59-69, 85,86, 88-90, 92,93,98
A	<p>US 5 491 552 A (KNUETTEL ALEXANDER) 13 February 1996 (1996-02-13)</p> <p>column 3, line 41 -column 7, line 62</p>	59-69, 85,86, 88-90, 92,93,98
A	<p>US 5 321 501 A (HUANG DAVID ET AL) 14 June 1994 (1994-06-14)</p> <p>column 6, line 22 -column 9, line 2; figure 1A</p>	59-69, 85,86, 88-90, 92,93,98

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**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-58,71,101,102

apparatus for optical imaging employing an interferometer, a spectral separating unit, and a plurality of detectors.

2. Claims: 59-61,62-66,67-68,69,85-86,88,89,90,92,93, and 98

apparatus for optical imaging employing an interferometer, a spectral separating unit, and a plurality of detectors.